

The Earliest European Acquaintance with Tropical Vegetation

by

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"Das Glanzstück der botanischen Mitteilungen über ost-indische Pflanzenwelt die unter Alexander erschienen, ist die Schilderung des riesigen Feigenbaums, des Banyan," wrote Hugo Bretzl in his massive work on the botanical results of Alexander the Great's invasion of northern India in 326-325 B.C., *Botanische Forschungen des Alexanderzuges* (1903). With this account of the banyan (*Ficus benghalensis* L.) preserved in Theophrastus's *Enquiry into Plants* (*pēri phutōn histōria*), there began well over two thousand years ago the European investigation of the genus *Ficus* in tropical Asia to which Professor John Corner has made such illuminating contributions. Theophrastus (370-c.285 B.C.) himself never went to India; as a pupil first under Plato, then under Aristotle, whose library and garden he inherited, and later as an academic teacher, he spent almost all his life in Athens. His career spanned completely the life of Alexander (356-323 B.C.), whose army undoubtedly included well-educated highly intelligent observers and recorders, and the reports of these officers came into Theophrastus's hands. Their firsthand accounts disappeared long ago but parts have survived, being embedded, like fragments of Roman masonry in medieval walls, within the writings of others, notably Theophrastus and Arrian, and among them is the description of the banyan, the Indian fig (*sukē hē indikē*), praised so highly by Bretzl. This occurs in Theophrastus's *Enquiry* IV. iv. 4-5.

Since so much of Professor Corner's life, research and writing has been devoted to the study of tropical plants, particularly those of Indo-Malaya, the celebration of his seventieth birthday provides a fitting occasion on which to bring to notice again these first records of the impact of tropical vegetation upon the receptive analytic Western mind.

Even for a present-day young botanist versed firsthand only in the north temperate flora, first acquaintance with the strange diverse vegetation of the tropics, with plants of a luxuriance and character unknown in Europe and North America, is a stimulating and mentally bewildering or overwhelming experience. A succession of narratives indicate that this has always been so.

Thus Henry Walter Bates arrived with Alfred Russel Wallace at Parâ, Brazil, on 28 May 1848, having left Liverpool on 26 April. They immediately walked across the town, then small and closely encompassed by native vegetation. "The impressions received during this first walk," Bates wrote in his *The Naturalist on the River Amazons* (1863) after eleven years in the Amazon valley, "can never wholly fade from my mind ... so striking, in the view, was the mixture of natural riches and human poverty ... But amidst all, and compensating every defect, rose the overpowering beauty of the vegetation ... Strange forms of vegetation drew our attention at every step." Tropical fruit trees, tall palms with smooth columnar stems, epiphytes perched amid boughs, slender woody lianes, luxuriant creeping plants overrunning alike tree-trunks, roofs and walls, sword-leaved bromeliads and many other plants remarkable in leaf, stem or manner of

growth together exemplified for them "the teeming profusion of Nature", to which, as night came on, the whirring of cicadas, the shrill stridulation of grasshoppers, each sounding its peculiar note, the hooting of tree frogs, the croaking of toads and frogs in pools together provided an audible expression almost deafening. This rich diversity had earlier affected Alexander von Humboldt and Aimé Bonpland as vividly. They arrived at Cumana, Venezuela, on 16 July 1799, having sailed from Spain on 4 June 1799. The effect of the tropical environment upon both the travellers led Alexander to write to his brother Wilhelm: "What trees! Coco-nut trees 50-60 feet high; *Poinciana pulcherrima** with a foot high bouquet of magnificent bright red flowers; pisang and a host of trees with enormous leaves and scented flowers, as big as the palm of a hand, of which we knew nothing ... We rush around like the demented; in the first three days we were unable to classify anything; we pick up one object to throw it away for the next. Bonpland keeps telling me he will go mad if the wonders do not cease."

Even earlier James Wallace (d. 1724), an Orkney man who had taken part in the ill-fated Scottish attempt of 1698-1700 to found a colony at Darien, Panama, wrote: "This place affords legions of monstrous plants enough to confound all the methods of Botany ever hitherto thought upon ... some of their leaves exceed three ells in length and are very broad, besides these Monsters, reduceable to no Tribe, there are here a great many of the European kindred but still something odd about them". The equally remarkable tropical vegetation of Amboina in the East Indies inspired Georg Everard Rumpf. (c.1627-1702) to the vast task of preparing his *Herbarium Amboinense* (6 vols, 1741-1750) which describes vividly and accurately some 1200 species.

In southern India the governor of the Dutch possessions along the Malabar coast, Hendrik Adriaan von Rheede tot Draakenstein (1637-1692), was so impressed by the diversity of plants there, particularly by the epiphytes — "on one tree ten or twelve different sorts of leaves, flowers and fruits might be met with," as he said — that he set in hand the preparation of a detailed account, on which were engaged himself, an Italian missionary, about sixteen learned Brahmins, four artists and various native collectors. His *Hortus Indicus Malabaricus* (12 vols. folio, 1678-1703) was the first major work to bring a tropical flora to the notice of stay-at-home botanists in Europe. He introduced the banyan into cultivation at Amsterdam.

These works were by-products of European conquest and dominion, above all of the establishment of the Dutch empire in the East Indies during the 18th century A.D., an empire reached only after a long and hazardous voyage around Africa. The first European contact with tropical vegetation likewise resulted from European empire-building in Asia, but was made overland in the 4th century B.C. Having defeated Darius in 331, Alexander marched his army into Turkistan (Bactria) and then in 327 invaded north-western India by way of the Khyber Pass and entered the Punjab; the river Indus became the eastern boundary of his extended Asiatic empire. Short-lived though this was, it led to a flow of Greek ideas and art into northern India and a flow of information about the country back to Greece. Such information must have been very extensive, since the surviving fragments of it, preserved in the writings of Theophrastus, Plutarch, Strabo and Pliny, for example, embrace Indian customs and geography as well as plants. Bretzl has so exhaustively collected all which is available of a botanical nature that were his book better known and easy to acquire — it seems to be scarce, is accessible in few libraries and has never been translated — there would be little justification for calling attention to this here. It deserves, however, not to be forgotten.

* *Caesalpinia pulcherrima* (L.) Swartz.

The banyan (*Ficus benghalensis* L.) is an evergreen tree widespread in India with entire leathery leaves and small red fruits, and rises to about 26 m. (85 feet) and by pushing down, from its horizontally spreading branches, supporting prop- or pillar-roots at intervals, spreads over so wide an area that, as Corner has said, it "develops the biggest crown of any plant in the world". One individual tree can thus make a small wood.

This habit of the banyan, sending down aerial roots from its branches away from the main stem, caught Greek attention. It raised moreover an interesting morphological question such as indeed could only be seen as a question when the study of plants had passed from being purely utilitarian, as was presumably that of unlettered herb-gatherers, the *rhizotomoi* (literally 'root-cutters'), to being scientific and philosophical as was that of Theophrastus and his associates, namely the distinction between root and shoot. Clearly Theophrastus rejected the common view that any underground organ of a plant is a root, in other words, that all underground parts are homologous, by emphasizing the differences between the tuber of arum, the bulbs of squill, garlic and onion and the roots they send out. "His whole treatment of the subject of the roots of plants reads as if he had gone stealthily to work," so E. L. Greene wrote in 1909, "to undermine an old and everywhere received opinion that roots are simply the underground parts of plants." He based his definition on natural function and not position. This means that roots like shoots can be aerial and the banyan, though he can never have seen it himself, had been so well described, possibly even sketched, by Greek observers in India that it provided a most remarkable example of them. "The character and function of the roots of the Indian fig are peculiar, for this plant sends out roots from the shoots until it has a hold upon the ground and roots again; and so there comes to be a continuous circle of roots around the tree, not connected with the main stem but at a distance from it" (Loeb Classical Library translation by A. Hort, 1: 41; 1916).

Theophrastus had indeed made a detailed study, very remarkable for his period, of the underground parts of plants, distinguishing between rhizomes, tubers, bulbs and roots and distinguishing within the last-named various types, a matter discussed by Greene (1909), Strömberg (1937) and Arber (1950).

Theophrastus's fuller account of the banyan occurs later in his work, in a section on trees and herbs special to Asia: "The Indian land has its so-called fig-tree which drops its roots from its branches every year, as has been said above, and it drops them not from the new branches, but from those of last year or even from older ones; these take hold of the earth and make, as it were a fence about the tree, so that it becomes like a tent, in which men sometimes even live. The roots are easily distinguished from the branches being whiter, hairy, crooked and leafless. The foliage above is also abundant and the whole tree round and exceedingly large. They say that it extends its shade for as much as two furlongs; and the thickness of the stem is in some instances more than sixty paces, while many specimens are as much as forty paces through. The leaf is quite as large as a shield, but the fruit is very small, only as large as a chick-pea, and it resembles a fig. And that is why the Greeks named this tree a 'fig-tree'. The fruit is curiously scanty, not only relatively to the size of the tree, but absolutely. The tree also grows near the river Akesines". The mixture here of plain fact and of exaggeration suggests strongly that it is a description made from memory, perhaps told to Theophrastus by a soldier returned from India. Thus the leaves of the banyan, though up to 20 cm. long and, 12 cm. broad, are much smaller than the smallest round shield (*pēltē*, Latin *pelta*) of the Ancient Greeks. Nevertheless, in addition to the general description of habit, this account contains two very significant remarks. The tree's prop-roots, though aerial, woody and stem-like, are distinguished from stems by being leafless (*aphullōi* seems a more correct rendering than the *diphullōi* of most codices). Moreover the fruits are compared to those of the

fig (*sukē*, *Ficus carica* L.) on account of their structure, though not their size; hence the Greeks classified the banyan as a fig, *sukē hē indikē*; this indicates real taxonomic insight since the banyan, except for these, is so utterly different from the cultivated Mediterranean figs.

Theophrastus also mentions in Book IV. iv. 5 other Indian plants, e.g. a very large tree with a large sweet fruit, presumed to be the jack-fruit (*Artocarpus heterophyllus* Lam.), another with a crooked sweet fruit, presumed to be the mango, (*Mangifera indica* L.), one with a fruit like the cornelian cherry (*Cornus mas* L.), presumed to be the jujube (*Zizyphus jujuba* Mill.), and another with an oblong leaf, like the feathers of the ostrich, 2 cubits (3 feet) long, presumed to be the banana (*Musa*).

The clothes of the Greeks were made from linen, hemp and wool. In India they found people wearing clothes that were the product of a tree with a leaf like the mulberry but resembling the wild rose; this was cotton (*Gossypium*); the plants were grown in the plains in rows, so that seen from a distance they looked like vines.

The mangroves on the sea-coast provided another kind of tropical vegetation wholly strange to men from the Mediterranean region, which has no counterparts to these trees growing in tidal waters and partly submerged at high tide. In December 325 B.C. the Cretan admiral Nearchus with a fleet built for Alexander on the Hydaspes (now the Jhelum) river sailed into the Persian Gulf from Pattala (now Tatta east of Karachi), then at a mouth of the Indus though now inland, while Alexander marched his army into Gedrosia, the modern Makran region of Baluchistan and adjacent southern Iran, evidently along the coast over part of the way, for Arrian, quoting Aristobulus, records mangrove trees: "one, with a leaf like laurel, is found growing below high-water mark on the sea-shore; this tree is left high and dry by the ebb tide, and on the succeeding flood looks as if it were growing in the sea. Some of them, growing in hollows which do not dry at low tide, are never out of the water, but even so take no harm from the constant immersion of their roots. Some trees are as much as 45 feet in height and were in blossom when Alexander saw them; the flower is rather like the white violet [i.e. stock, *Matthiola incana* (L.) R. Br.] but much more fragrant" (Arrian, *Life of Alexander the Great*, transl. A. de Sélincourt, 214; 1958). This was either *Avicennia marina* (Forsk.) Vierh. or *Rhizophora mucronata* Lam.

An essentially similar account, derived evidently from Nearchus's voyage past the mangrove-fringed creeks on the northern coast of the Persian Gulf, occurs in Theophrastus's *Enquiry*, IV. vii: "There are plants in the sea which they call 'bay' [*daphnē*, *Laurus nobilis* L.] and olive [*ēlaia*, *Olea europaea* L.] in foliage the 'bay' is like the aria [*aria*, holm oak, *Quercus ilex* L.], the 'olive' like the real olive. The latter has a fruit like olives." To this Theophrastus added: "On the islands which get covered by the tide they say that great trees grow, as big as planes or the tallest poplars, and that it came to pass, that when the tide came up, while the other things were entirely buried, the branches of the biggest trees projected and they fastened the stern cables to them, and then, when the tide ebbed again, fastened them to the roots. And that the tree has a leaf like that of the bay, and a flower like gilli-flowers [*iōn*, *Matthiola incana*] in colour and smell, and a fruit the size of that of the olive, which is also very fragrant. And it does not shed its leaves, and that the flower and the fruit form together in autumn and are shed in spring." The roots to which the ships were fastened at low tide must have the prop-roots of *Rhizophora*, but evidently the Greeks were not there at the right time to observe the viviparous germination of the fruit; otherwise they would surely have noted the long club-shaped radicle produced while the fruit still clings to the bough.

Theophrastus also incorporated observations referring to *Avicennia marina* made on the northern coast of the Persian Gulf, probably in the Strait of Hormuz

near Bandar-Abbas, southern Iran: "In Persia in the Carmanian district where the tide is felt there are trees of fair size like the andrachne [*andrachlē*, *Arbutus andrachne* L.] in shape and leaves; and they bear much fruit like in colour to almonds on the outside but the inside is coiled up as though the kernels were all united". This obviously refers to the longitudinally folded cotyledons, one enclosing the other, in the seed of *Avicennia*. "These trees are all eaten away up to the middle by the sea and are held up by their roots".

Through an exploratory voyage by Androstenes along the southern coast of the Persian Gulf the Greeks also became acquainted with the island of Tylos, a very ancient centre of trade and civilization, now known as Bahrain, and recorded some of the plants grown there, as noted by Theophrastus. These included cotton, date palms, an evergreen fig and vines. They also stated "that there is another tree with many leaves [i.e. leaflets] like the rose and that this closes at night but opens at sunrise and by noon is completely unfolded; and at evening again it closes by degrees and remains shut at night, and the natives say that it goes to sleep". This is the first record of the sleep-movement of the tamarind (*Tamarindus indica* L.), indeed of any plant.

Bamboos are so important in the rural economy of India and grow there to so much greater heights than those of the two similar plants known to the Greeks, the common reed (*Phragmites australis* (Cav.) Trin. ex Steud.) and the giant reed (*Arundo donax* L.), that it would be strange indeed if the Greeks had failed to mention them at all. Theophrastus's reference to them in his *Enquiry* IV. xi. 13 is, however, brief: "The Indian reed is very distinct and as it were of a wholly different kind; the 'male' is solid and the 'female' hollow ... a number of reeds of this kind grow from one base and they do not form a bush, the leaf is not long, but resembles the willow leaf, these reeds are of great size and good substance, so that they are used for javelins". The terms 'male' and 'female' are used here metaphorically as they were for other plants, excluding however the date-palm; the 'male' has been identified as *Dendrocalamus strictus* (Roxb.) Nees, the 'female' as *Bambusa arundinacea* (Retz.) Willd.

Since Theophrastus, Arrian and other Ancient Greek writers only incorporated such information about tropical plants and vegetation as was relevant to their own work, almost indeed incidentally, it is reasonable to believe that the sources whence this came must have contained much more which has long been lost. Theophrastus's task in his botanical writings — he also wrote on astronomy, education, ethics, logic, mathematics, odours, meteorology, religion and rhetoric — was to bring together an immense quantity of information, no small part based upon his own observations, which he presented in a classified form, using facts not simply for themselves but also to provide examples for general statements, giving particular attention to differences which delimited or expressed the essential nature of subjects. It was his intention not to list all the known individual kinds of plants but simply those characteristic of certain features or regions. His fourth book in the *Enquiry* deals with the plants special to particular districts and habitats; in the sections relating to Asia, since he had never been there himself, he accordingly extracted what seemed especially interesting or relevant from the writings and recollections of his contemporaries who had accompanied Alexander on his invasion of India. Indeed he said "there are also many more different from these found among the Hellenes, but they have no names. There is nothing surprising in the fact that these trees have so special a character; indeed, as some say, there is hardly a single tree or shrub or herbaceous plant, except a few, like those in Hellas".

The task of Arrian, who lived some four hundred years later, was to write a reliable biography of Alexander, again taking what seemed relevant from earlier sources. The loss of these sources is not surprising. Thus the immense libraries of Pergamon and Alexandria had virtually perished by the 5th Century A.D., their

decline hastened by fanatical Christians who regarded them as pernicious repositories of pagan literature. Because of this, the effect upon the Hellenic world of the new knowledge stemming from Alexander's Asiatic conquests can only be dimly surmised. In the field of botany it enlarged European vision by bringing to notice plant structures, such as the banyan with its prop-roots, and ways of life, such as that of the mangroves growing as trees within the sea, as well as individual plants, which had no counterparts in Europe. Various European plants perform nyctitropic movements of the leaflets but none so conspicuously as does the tamarind. This extension of biological concepts through contact with tropical vegetation is necessary to counteract the impoverishing narrowness of outlook and experience which afflicts botany taught from a few plants in the laboratory by teachers who have never felt the excitement of seeing the plant world in its most complex form, above all in tropical rain forest regions. As Professor Corner has said in the last chapter of his *The Life of Plants* (1964), "high rainfall, sunshine and temperature make the tropical forest the prime of plant life ... But the forests, which show how trees were made, are going. They are vanishing nowhere faster than from the alluvial plains where the vestiges of the last creative phase of plant life, that prepared the way for the modern world, may survive". Because Professor Corner, with a stimulating breadth of outlook fostered in the tropical environment of Malaya, has striven so much to make stay-at-home European botanists aware of the evolutionary significance of tropical plants and the urgent need to study them before destruction of their habitats deprives humanity of many of them forever, it has been appropriate to recall here the first chapter in the history of European botanical contact with their challenging diversity.

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